

Hot Iron

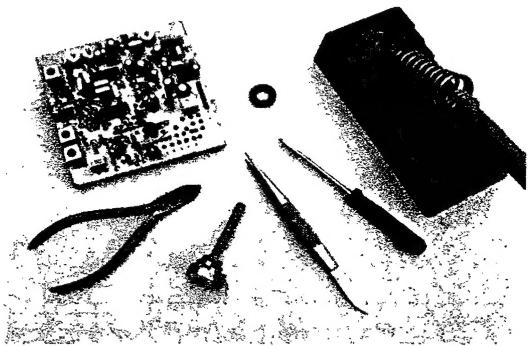
Autumn 2002
Issue 37

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Editorial

All change thanks to complex technology! A few weeks back, my computer suddenly said it had an 'unmountable boot volume' and died! Getting it going again lost everything that was not properly backed up and that included my last style version for Hot Iron. I spent nearly an hour trying to make Word do what I wanted and failed hopelessly so this is with MS Publisher—keep your fingers crossed!



Time and again, kit customers say they most enjoy operating with simple rigs. Interestingly, a later article about PSK31 laments the character implicit in simple forms of communication. Because things can be done with many variants and high degrees of sophistication, it does not always mean they give more pleasure nor are they always easier to use! I am certain that if I spent more time at it, I would come round to these benefits but just at the moment I long for a blank sheet of paper and a pen! Wish my writing was more legible!

Kit Developments

A relatively minor addition has been an **audio amplifier**. This has two sections, the first which can act as a speech amp, drives a PCB mounted shafted preset which is followed by an LM380 power amplifier. Uses include driving a loud speaker instead of phones or as a low power modulator for an AM rig. More on that later I hope!

The next major new project is the **Fivehead** transceiver. This has portable operation as a theme. It is an any single band phone superhet producing nominally 1.5 Watts (on 13.8 volts) for any band to 20m by direct VFO injection. There will be several options for enhancements; higher bands using the **Mixer** kit—hopefully to 10m, semi break-in CW with the **CW** kit, S and Power out/reflected readings (and AGC) with the **Meter** kit, 5 digit readout with the **counter**, **speech processor**, and a forthcoming 10 Watt **Linear** amplifier. Target price is near £85 without the extras! Sorry I can't throw them in! I have a prototype nearly working on 80m and could do with some early builders if anyone is interested. The main PCB is 100 mm square and is a bit full—it's actually the one in the picture above—with the output LPFs yet to fitted! I have to add some parts to the layout to improve the muting (see later) and do several other tests so it is not quite available yet! Let me know if you are interested. Tim Walford G3PCJ

Hot Iron is a quarterly subscription newsletter for members of the Construction Club. Membership costs £6 per year with the first issue for each year appearing in September. Those people joining later in the year will be sent the earlier issues for that year. Membership is open to all and articles or questions or comments or notes about any aspect of electronics—principally on amateur radio related topics—is very welcome. Notes on member's experience building their own gear, from kits or otherwise is most interesting to other constructors. To keep it interesting, your thoughts and ideas are required please! For membership, I only need your name and address and subscription. Send it or any other suggestions to Tim Walford, Walford Electronics, Upton Bridge Farm, Long Sutton, Langport, Somerset TA10 9NJ © G3PCJ

PSK31 AND ME

Some time ago "PSK31" was introduced to the Yeovil Amateur Radio Club by G3TSK and M5EVT with a talk and demonstration of the mode. This was followed up by an article by G3TSK in Yarcnews and a demonstration set up at the 2001 QRP Convention by both of them.

Before the talk I knew nothing about the mode and gleaned that it was a CW mode with the letters in PSK31 standing for Phase Shift Keying and the figures for the bandwidth of the system, namely 31 Hz. This is a remarkably low bandwidth and the consequent reduction in noise level allows stations with very low strength signals to be resolved. The mode uses transceivers running in SSB (usually USB) mode and the CW Morse is derived from the modulating audio signal with phase shift keying. The RF operating frequency is the absolute frequency of the audio signal which in the USB case is added to the carrier frequency. As far as I know the nominal RF frequencies are universally agreed for each band and for the twenty metre band it is 14.070 MHz. As you might expect all this is done under computer control for which there are a number of free programmes available, the most common being "DigiPan". The bottom of the screen of the computer shows a "spectrum analyser" display of the SSB band with the incoming PSK31 signals clearly displayed against a horizontal frequency scale. Above this are two windows, one for decoded incoming signals and the other for the out going message(s) either transmitted or to be transmitted in Morse. Whatever message is held here, it will be transmitted when the system is changed over to transmit.

All this was very intriguing and so recently I decided to have a go myself and find out what it was really like to operate in CW without using a key. One of the things that was very apparent when listening (perhaps I should say viewing) incoming signals was that most seemed to be of a standard format which was precisely repeated for different QSOs except for the callsign of the station being worked or the operator's name. This standard format does not seem just apply to a particular station but is common to different stations, the only changes being the personal ones such as the name and the QTH. This is obviously due to the same software being used together with the standard formats of messages that comes with the software. Another thing is all signal reports seem to be 599 but as the signal strengths are well below that normally attributed to S9 this is even more ridiculous than that commonly heard on CW, the "599 please repeat" report. Further as the signal cannot be normally heard how do you know it is T9? It seems to me that the only valid report that can be given is "your signals are R5, R4, R3 etc.". Another problem is that if you want to have a non-standard format QSO then you have got to be able think what you want to say and to type fast enough to keep the text flowing. To the majority of us this is just not possible and so the QSOs are punctuated with long pauses whilst the operator thinks what he wishes to say and then starts to type it on the keyboard. In a normal CW QSO there is often a pause for thinking but the operator, without intruding on his train of thought, will normally send AS or BT to let the recipient know that he is still there.

Were the QSOs I had worth while? The answer is "NO!". There was no "job satisfaction" using the keyboard with the whole QSO seeming to lack any life and I did not feel that I was working a living individual. Compare this with real CW when one can converse back and forth using the "BK" method where the callsigns only have to be sent once every quarter of an hour to satisfy the licence conditions.

So at the end of the day what do I think of PSK31. The answer is not much. I have great admiration for the technicalities of the mode and recognise that it is a great step forward over the old RTTY modes. However in my opinion it is not a "living mode" and it gives me the feeling of working in a graveyard.

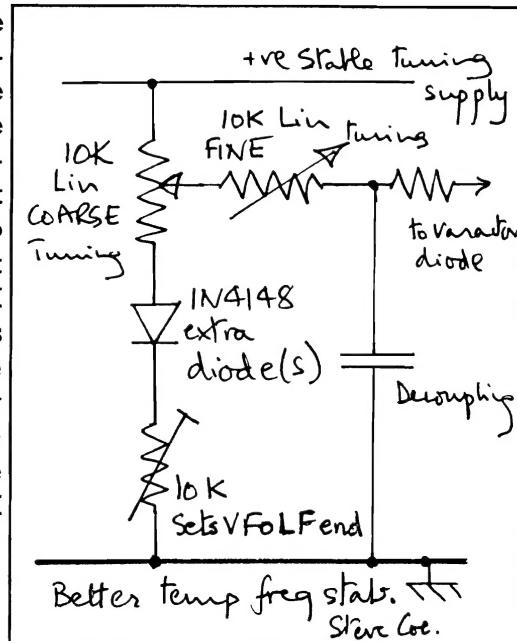
No, give me a pair of phones connected to a simple transceiver, a well tempered resilient morse key, a spot of QRM and I shall be pounding brass as happy as the proverbial pig.

Eric Godfrey, G3GC

Rig Updates

Midney RX Steve Coe has added an extra diode to the tuning arrangements of his Midney which improves its frequency stability under varying temperature conditions. See right. The diodes are connected in series with the negative end of the main tuning pot; their diode drop voltage decreases with increasing temperature so helping to counteract the effects of changing temperature which are mainly due to the varactor diode. He has tried up to three extra diodes, but the more you have, the lower the available tuning range. I suggest that in most situations a single diode connected as shown right is the best compromise. After adding a diode you will need to rest the lower frequency end of the tuning range with the preset in the tuning voltage chain. The VFO HF end should not be affected. It should also work if you have changed the normal 10K Coarse/Fine pots for a single 10K multi-turn pot.

Note! This scheme might also benefit the **Bristol** and other rigs with varactor tuning for their main tuning control.



Bristol TCVR Over the years, some builders have found that aligning the 20m LO BPF is rather tricky to get the best compromise between LO signal amplitude and purity. The cause of this difficulty is that, on 20m, the LO crystal frequency is 4 MHz and the desired LO is nominally 8 – 8.5 MHz after mixing with the 4 to 4.5 MHz VFO; hence the second harmonic of the crystal is likely to be right on the wanted LO band edge so the LO BPF cannot remove it. This harmonic is sometimes uncomfortably large and leads to lots of 'fuzz' on the tips of the LO signal if viewed on a scope. This makes it a pretty hard waveform for a scope to trigger on properly hence the confused display. Another symptom is that the fuzz's characteristics change quite rapidly with small changes in VFO frequency. This is because the frequency difference between the wanted LO frequency and the crystal's second harmonic is changing rapidly. Following discussion with Simon Bea G7CPN/M3BGA whose Bristol was particularly troublesome, we found the best solution is to reduce the amplitude of the 4 MHz crystal oscillation and hence also its harmonics. This can be done quite easily by adding a 1K resistor directly across the 4 MHz crystal. Note this has to be done on the band card so that it affects only the desired bands. Simon also applied the same modification for the 30m band.

Note! This suggestion applies other rigs (**Taunton etc.**) using the same frequency scheme.

Electrical Safety

Prompted by reports of an accidental death while someone was using a sander to complete a job for a friend, I surmise that the premises concerned did not have an earth leakage trip or residual current device (RCD). I do urge all readers to **CHECK NOW** if you have a residual current device (RCD) protecting your electrical installation (assuming you do not already know the answer). RCDs can be installed to protect individual sections of your electrical installation, such as a ring main serving several 13 Amp sockets, or the whole installation. You can also obtain 13 A sockets which have their own RCD within their body. The modern RCD works by sensing inequality between the currents in the two principle conductors of the mains supply, any difference between them means that some current is escaping to earth in a faulty manner so it turns itself off. There are various sensitivities for different applications. All RCDs have a test button which applies a small fault current; they should be tested every 6 months or so to check operation. The smaller the trip current rating, the better the protection but this can lead to nuisance tripping for large 'circuits'. 15 mA is often used for personal protection and 30 mA for general work. Your shack mains supply should certainly be protected by an RCD but I would strongly recommend that your whole electrical installation should be so protected. If you have the older style of voltage operated earth leakage trip, they are better than none, but not as good as the modern current operated RCD.

On a separate point, real RF earths of antenna systems and mains earth must NOT be connected together - especially where mains earthing is by protective multiple earthing (PME). G3PCJ

One off construction methods

Andy Howgate G7WHM/M3ADA tells me in an e mail about how he is building a new small transceiver based on the Compton and Butleigh circuits.

"I suppose the technique could be described as ugly bug—not sure what you would call it—it uses a single clad PCB with the copper side acting as the ground plane which allows all earthy connections in close proximity to the individual components. The copper clad side is counter sunk where non earthy component leads pass through the PCB, these are then folded over on the insulated side and routed as if they are the circuit tracking. This allows build as you go, using a pin drill and countersink bit and hence allows for extreme miniaturisation. Component size is not so critical and one can use what is to hand and fits into available space and thus no great forward planning is required or any special pc programs or messy etch stuff. Not suitable for a repeatable product, but for my needs, perfectly suitable for a one off.

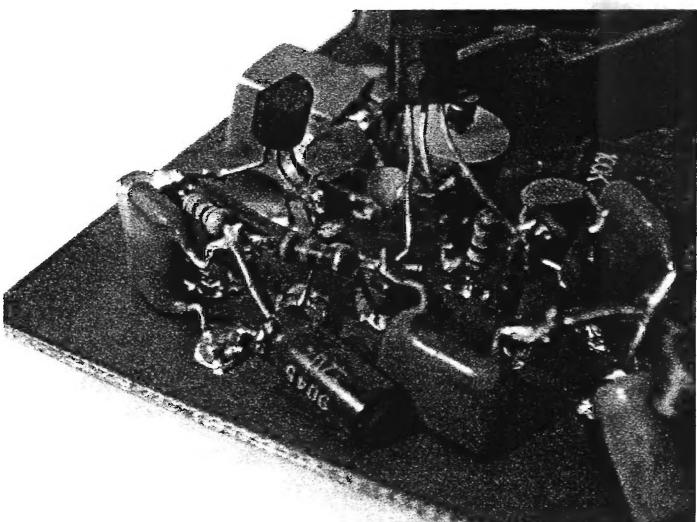
The track or wire side does not look so neat as an etched PCB but the ground plane side with components looks smart. The supply lines are linked from one point to the next with insulated wire and all ground or 0 volt connections are made directly to the ground plane. When completed, the wired up side can be brushed over with lacquer which will bond the whole lot together and offer insulation etc and ensure rigidity. Looking at the top-side, you would be hard pressed to tell the difference between a properly laid out PCB and this one! Removal of a component is probably not so easy, especially with items like a chip, but in certain applications one can use a DIL socket—audio circuits are ok but RF devices maybe risky. It depends on what one is building, transistors and two wire devices are easy to remove either by cutting the longish wires or de-soldering and using a spring hook to detach the wire from that particular joint. Its not perfect but in my opinion better than island pad or 'dob' boards and spending hours track drawing, etching & drilling. The whole process of assembly is completed in one operation - find suitable location then drill component holes, add countersinks, fit component, bend and route wire ends to suit, solder them to the next part & solder any earthy points on to the ground plane direct. It sounds time consuming but in reality very little time is taken, about 45 minutes from cutting my PCB to size, cleaning copper, finding suitable components from my part bins/junk boxes, drilling and fitting them. About an hour to have the LM380 audio chip up and running. One is working from the circuit diagram direct.

I think the technique is perfect for trying ideas before committing to a full PCB layout, and then finding out you have to start again because your design does not perform as you would like! This method does allow changes to the layout as you progress. If you use paxolin copper coated material, it is cheap by comparison to double sided fibre glass PCB. It is really much like using perforated board of days gone by, but the clad side is your screen and earthing point. The tools needed are simple pin drill, track cutter or battery powered drill, pointed pliers for bending leads, side cutters, solder and an Iron. Oh! And a paper clip straightened out with a small hook bent on the end (spring hook) – this being used to pull a wire from a connections when heated with the iron for component removal. Much quicker than designing a PCB, etching it, getting your friend to do the drilling, collecting, building, and then doing a Mk 2 after debugging! But a steady hand is needed!"

I had sent Andy some components for this rig and he comments that he will have them in and working 20 minutes after unpacking! I have often used another version of this style of building which I know as 'dead bug' construction. This does not involve any drilling—it has all components mounted only by their earthy leads direct to the copper ground plane. Connections are then made direct between individual parts, with plenty of extra 10 nF decoupling capacitors are used to anchor the supply lines. Chips are mounted upside down with their legs in the air—hence its name! If really necessary, 10 M resistors can be used to anchor other nodes and are unlikely to affect circuit impedances. See photo below for one of mine! G3PCJ

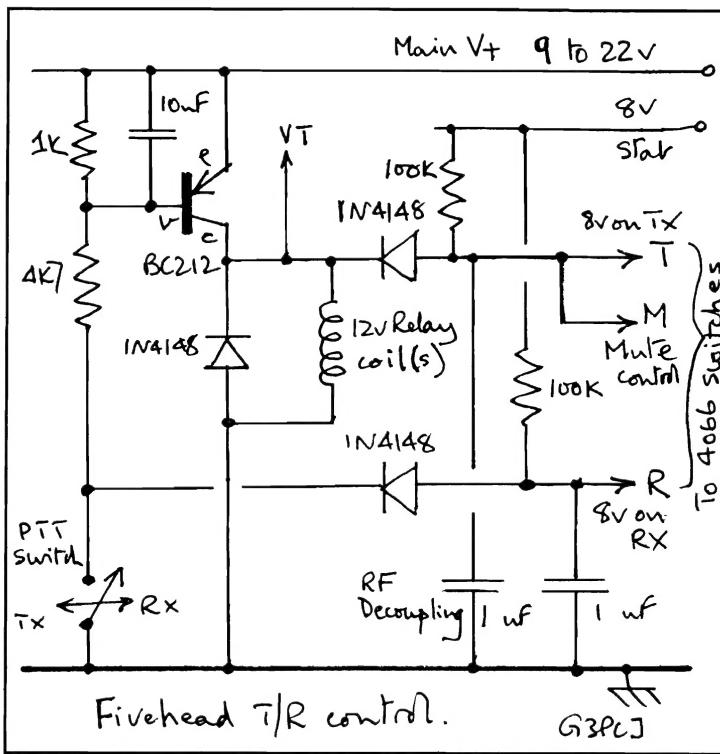
Correction!

Derek Alexander G4GVM points out that I made a mess of his computer interface circuit diagram in Hot Iron 36! "When at rest the relay should allow the mic to operate the rig, and the mic's PTT to make the rig go to transmit. Only when the computer operates the relay, is its o/p connected to the rig mic I/p and its PTT circuit can then put the rig into transmit." The top set of relay contacts in the published diagram need reversing. My apologies—please ask me or Derek if you need any further information to make it work properly, Tim.

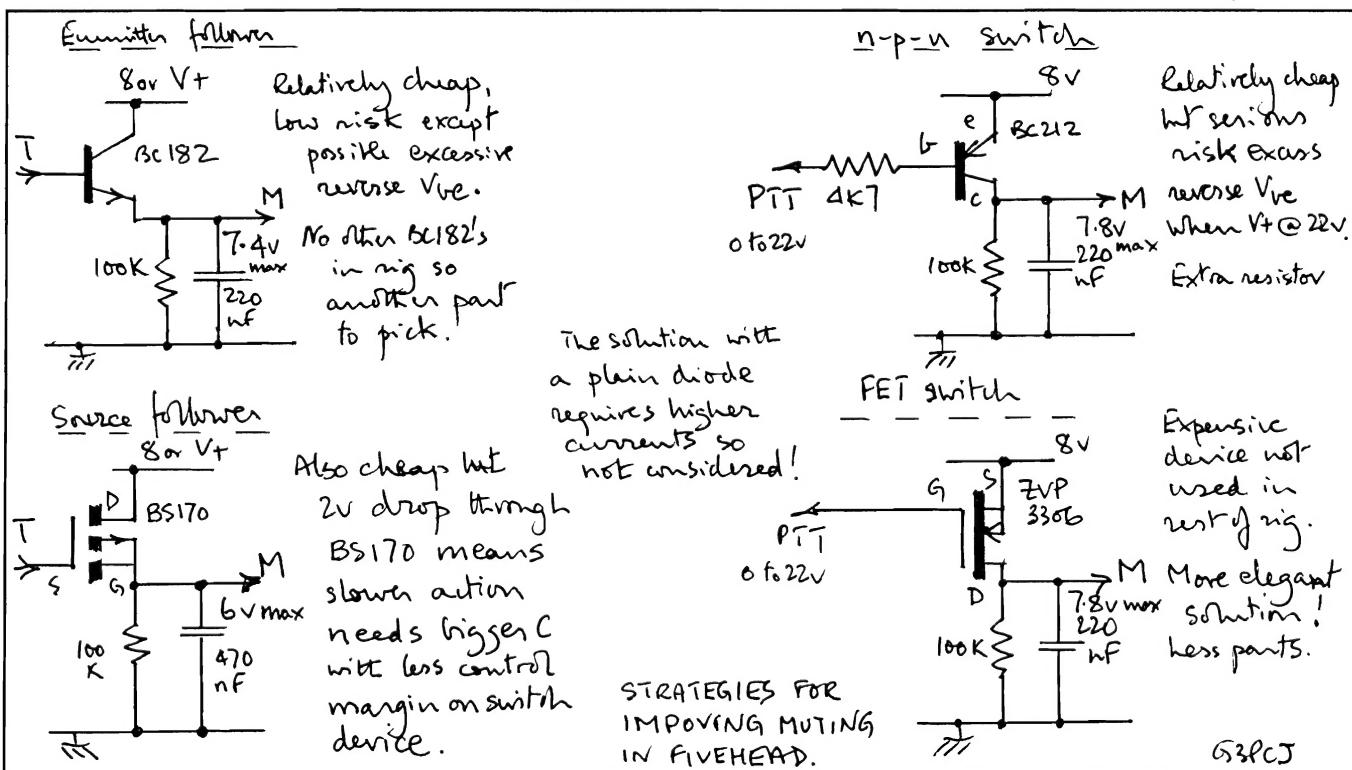


Design Choices!

You might be interested to see some of the considerations when I find that modifications are needed to a rig during its prototype testing! In this case, I found that the muting of the **Fivehead** was poor allowing clicks to come through the receiver audio on the change over both from reception to transmission and vice versa. Not only is this uncomfortable when using phones for CW, but these clicks would also desensitise the RX AGC loop if a Meter kit were fitted. (These TR clicks are a different problem from the potentially annoying clicks due to CW key action.) The requirement is for the muting to turn on very quickly, before the TR relay changes over to transmit, and to go off slowly after the relay has reverted to reception—the intention being to mask the transients caused by the swift changes of the high relay current flowing in the inductive relay coil(s).



The original design shown above did not hold the muting beyond the TR relay supply voltage being removed —this means that at least a diode and CR time constant has to be added —about four more parts. The Fivehead's muting uses one section of a CMOS switch chip to place an audio short across a high impedance point in the audio path prior to the AFG pot. Other sections of the 4066 switch chip route the signals between the IF filter and the two mixers. These chips use an 8 volt supply but their control signals are related to and derived from the rig's main positive supply which can be up to 22 volts! Thus their control signals (including that for muting) have also to be limited to 8 volts. The diagrams below show four possible approaches using different transistor technologies to derive a fast attack and slow decay of the mute control signal. The pros and cons are noted for each. Space is very tight on the PCB so that I fear I shall not be able to squeeze in even these few extra components for any of the solutions without a wire link. You will have to buy a Fivehead to find out which I will eventually choose as I have yet to make that choice! G3PCJ



A Wurzdon or Two

I recall exchanging e mails with Tim some time last year regarding a very good friend of mine (Dave Buddery G3OEP) and his tireless efforts to promote Ham radio. The main subject was that another friend Bob and I fancied assembling a rig as a gift for Dave. I had explained to Tim that Dave rather liked some of the old equipment such as regen receivers and that he still regularly used an ex German war department receiver which happened to be a regen. I am unsure if this was the inspiration for the Wurzel design or perhaps it just turned out that the receiver was on the drawing board already, it didn't really matter too much but only that a design was available.

The final realisation was a three band radio with a matching crystal/resonator controlled transmitter on the QRP frequencies. The Wurzdon, as I called it, had several additions as I plodded along trying to make this transceiver into what I thought would be a nice gift. The Wurzdon would be used by an 80 year old whose hearing was not what it should be, so with Tim's help and advice and the supply of additional parts, the Wurzel gained an audio amplifier and CW filter so as to drive a loud speaker or phones with a higher output level. The matching CW transmitter had provision for one LPF so an additional PCB was assembled with the extra LPFs and switch used to select both appropriate crystal and filter. The Wurzel retained its normal band switching scheme. The transmitter, known as the Dundon, had no side tone so a simple system using a piezo sounder and steering diodes was fitted which worked very well. By experimentation, by far the best way to silence the Wurzel, and remove key thumps during transmit, was to disable the regen potentiometer and remove the audio output from the audio output jack using the spare contact set on the Dundon's relay.

So as to give as many operating parameters as possible, a switch was fitted to enable operation of transmitter with out the Wurzel so that another receiver could be used if desired. Since the Wurzel and Dundon are separate units, Tim had provided a netting switch so that the selected local oscillator in the transmitter could be tuned into by the receiver to check that the two were operating on the same frequency. Finally the rig was boxed and lettered and we waited for our special event.

Dave, who had now been presented with his rig, phoned me two days later to inform me that he was having an awful lot of fun and had had several excellent contacts with good reports and he was now planning a day out working portable. The regen principle has been around a long time, for much of Dave's life, as he is almost 80 years of age! Later on, Dave was formally presented with his rig by the Lowestoft Club at a special barbecue event in recognition of his contribution to amateur radio over many decades by their Chairman G3IWC, see the colour photo in the Sept 2002 Radcom page 74.

I now had a problem! My work bench was now empty of a project and I kind of missed the Wurzdon so it wasn't too long before a Wurzdon Two was under way; experience gained on the mark one resulted with the mark 2 being a little smaller, a little neater in appearance, with a proper side tone working into the audio output and a variable antenna attenuator control for the receiver made an even better rig but that is another story and I will not be parting with this rig!

My thanks to Bob M1CQR who helped with construction of the Wurzdon and The Lowestoft radio club for the financial assistance and organisation of the event.

Andy Howgate G7WHM/M3ADA

Editors Note! I was very pleased to be able to assist in this project since Dave B (as I know him!) has been a long standing customer and enthusiast of my simpler designs. Latterly he has kindly written up some interesting notes about very early DF work and the 'Hippersly Hut' which existed in East Anglia and possibly another in Somerset during the First World War. After a little more local research I hope to put this material in a later Hot Iron.

I must also thank Andy very much for taking the following photos of the Wurzdon and also for getting them copied. For those interested, the Wurzel is a simple regen receiver for the 20, 40 and 80m bands which normally drives Walkman type phones. I can supply it at the special price of £35 for Construction Club members. The Dundon is a 1.5 Watt 'crystal' controlled CW transmitter that can also be made to work on 20, 40 or 80m. Tim G3PCJ

